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EFFECT OF ORGANIC (COW DUNG SLURRY) AND INORGANIC (N: P: K 15:15:15) FERTILIZER ON THE GROWTH AND YIELD OF TOMATO (*LYCOPERSICON LYCOPERSICUM*) IN ANYIGBA, KOGI STATE, NIGERIA

Aina O.A, Agboola K. and Adava I.O and Eri A.

Department of Soil and Environmental Management Faculty of Agriculture Kogi State University P.M.B 1008, Anyigba, Nigeria

ABSTRACT: *A pot experiment was conducted in April 2018 in faculty of Agriculture, Kogi state university, Anyigba. The experiment was laid in a completely randomized design (CRD) with five treatments in four replications and results obtained were subjected to analysis using ANOVA and means were separated at 5% level of probability using Fisher Least Significant Difference Test. The treatment consisted of a control (T_0), 2 tonnes/ha of cow dung slurry + 50 kg/ha of NPK 15:15:15 fertilizer (T_1), 4 tonnes/ha of cow dung slurry + 50 kg/ha of NPK 15:15:15 fertilizer (T_2), 6 tonnes/ha of cow dung slurry + 50 kg/ha of NPK 15:15:15 fertilizer (T_3), 8 tonnes/ha of cow dung slurry + 50 kg/ha of NPK 15:15:15 fertilizer (T_4).Data were collected on plant height, number of leaves, stem girth, number of branches, number of fruit per plant, and fruit diameter respectively. It was observed that the organic and inorganic manure used increased the soil physical-chemical properties as well as the performance parameters of the test crop (Tomato). Recommendation was made at the rate of 6t/ha of cow dung slurry +50kg of NPK 15:15:15 (T_4) for optimum yield and performance of tomato.*

KEYWORDS: Tomato, Organic, Inorganic, Growth, Yield, Fertilizer, Cow dung slurry

INTRODUCTION

Tomato (*Lycopersicon lycopersicum*) is an herbaceous plant, usually sprawling plant in the solanaceae family or night shade family. It is grown widely for its edible fruits and it is one of the most widely grown important nutritious vegetables in the world. It originated in tropical America (Salunkhe *et al.*, 1987) particularly in Peru, Ecuador, Bolivia of the Andes (Kaloo, 1986). The crop is adapted to a wide range of climates ranging from the tropics to within a few degree of the Arctic Circle. It is now successfully grown in the tropical, sub-tropical and temperate climate. The present world leading tomato producing countries are China, India, USA, Turkey and Egypt (FAO 2012).

The United States of America is the world leading importer of Tomato. Most Tomato paste producing company has closed due to low access to raw tomato product, a notable example is Eriko tomato and recently Dangote tomato paste plant was shut down leading to high importation of tomato paste into the country. Nigeria spends up to USD 1 billion annually in tomato paste importation.

The main way of increasing production of any crop depends on soil condition and improved production technology. The maintenance of soil fertility through the use of nutrient is therefore important. Nutrients are applied to the soil through organic and inorganic means. Indiscriminate use of inorganic fertilizer is believed to cause deterioration of soil texture, structure, hinders microbial activity, pollutes ground water and finally decreases soil fertility and production; on the other hand, the use of organic manure improves texture, structure, humus, aeration, water

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holding capacity and microbial activity of the soil. All these in return increase production and reduce environmental pollutions (Pare *et al.*, 2000).

Inorganic fertilizers are substances which when added to the soil help to improve crop yield (Olaitan, and Omonia, 2006). Tomato is cultivated mostly on subsistence basis in rural areas. Mineral fertilizers are commonly applied by growers to maximize yields. However, in Nigeria, most rural farmers avoid the use of fertilizers, including N.P.K. 15:15:15, on their tomato farms. This is because fertilizers are scarce and expensive. Also, the price of tomato is usually low, partly because of lack of an affordable and effective means of preservation. The low price discourages the use of high cost fertilizer input. Rural farmers prefer, instead, to use fertilizers for other crops like yam, maize, cassava where the investment makes economic sense (Ogunwole, *et al;* 2006).

Organic fertilizers are farmyard manure (FYM), sheep manure (SM), poultry manure (PM), and compost among others has been used for crop production for centuries. The use of these forms of fertilizers certainly pre-date chemical (mineral) fertilizers, which is of more recent development in comparison with organic fertilizers. Organic fertilizers are more environmentally friendly, since they are of organic sources. Contrary, observations show that continuous use of mineral fertilizers creates potential pollution effect on the environment (Oad, *et al*., 2004).

MATERIALS AND MEHODS

Experimental site

The experiment was conducted in 2018 cropping season at Kogi State University in Faculty of Agriculture (Latitude 7° 30^1 and Longitude 7° $09E^1$), Anyigba in the Southern Guinea savannah agro ecological zone of Nigeria. The studied area which is Kogi State lies in latitude 5° 15^1 to 7° 45^1 and longitude 5° 45^1 and 8° 45^1 East of the equator. The mean annual rainfall is 1,808 mm at Anyigba in the East. The dry season generally extends from November to March. During this period, rainfall drops drastically to 12. 0 mm in any of the months. Temperature shows some variation throughout the years, with average monthly temperature varying between 17°C and 36.2°C. The State has two main vegetations: the forest savanna mosaic zone and the southern guinea zone. It also has two main geological formations, they are: the Basement complex rocks to the west while the other half is on cretaceous sediments, to the north of the confluence and east of River Niger (Amhakhian, *et al.*, 2010). The soils like most soils in north central agricultural zone of Nigeria have high erodibility, structurally weak, coarse textured with low organic matter status (Amhakhian, *et al.*, 2010).

Soil sampling and analysis

Soil samples were collected from each pot after harvesting for post-planting analysis, the samples were properly labeled and transported to the laboratory for physical and chemical determinations; In the Laboratory, the samples were gently crushed and were sieved through a 2mm mesh to have particles less than 2mm for the following analysis; Particle size Determined by Bouyocous hygrometer method (Bouyocous1962), the textural classes of the soils were also determined using the textural triangle; total N (%) was determined by macro-Kjeldahl method (Bremner, 1982). Available P (ppm) was found using Bray I method according to Olsen (1982).

ISSN: 2054-6319 (Print), 2054-6327(online)

Soil pH values were obtained by using a pH electrode meter (Jackson, 1973). Soil organic carbon was determined by Walkley-Black procedure (Nelson and Sommers, 1982).

Experimental Design and Treatments

An experiment was laid out in a completely randomize design (CRD) with four replications to investigate the effect of organic and inorganic fertilizer on growth and yield of tomato. The experiments comprised of five treatments as follows: T_0- No application (Control), T_1 - 50kg/ha NPK + 2t/ha cow dung slurry, T_3 - 50kg/ha NPK + 4t/ha cow dung slurry, T_3 - 50kg/ha NPK + 6t/ha of cow dung slurry, T_4 - 50kg/ha NPK + 8t/ha cow dung slurry.

Agronomic activities

In the nursery, Seeds of tomato hybrid (Rio Grande) were sown on a flat bed for 4weeks before transplanting to the pot. Weeding was carried out manually through hand picking of weeds. Organic manure were uniformly spread inside the pots and incorporated two weeks before transplanting. NPK fertilizer was applied four weeks after transplanting to compliment the effect of the organic manure. The seedlings were transplanting at the rate of two-plant-per-pot at a spacing of 75cm by 50cm which make up forty stands per twenty pots. Weeding was carried out manually at three weeks interval.

Measurement of physiological and growth parameters

Plant height was measured from the ground level to the growth point with a meter rule in centimeters and the observations were recorded at two weeks interval for the period of 8 weeks for each treatment. Number determined by counting the leaves including the senescent leaves at every two weeks for the period of 8 weeks. Also, the numbers of branches were also counted and the stem girth measured using the venier caliper. The total number of fruit clusters was counted for each treatment and then the mean was calculated and recorded. The observations on fruit weight for each treatment were recorded at the time of harvest. After each harvest, the individual fruits were weighed and the data on fruit weight was summed up and expressed in gram. The observations on yield were recorded at the time of harvesting. After harvesting, the tomato fruits were weighed from each treatment pots.

Data Analysis

All data were subjected to analysis of variance (ANOVA) and means found to be statistically significant was separated using fisher's least significant difference (FS) at 5% level of probability.

RESULT AND DISCUSSIONS

The physicochemical properties of the soil in the study area were given in the Table 1. The results showed that the texture of the soil was Loamy sand and was slightly acidic in nature with PH of 5.6. The organic carbon content was very high (0.52%). Total N was very low (0.026 g/100g). The available P and potassium were medium with values of 8.02 mg/kg-1 and 4.31Cmol/kg-1 respectively. The cation-exchange-capacity was high. Generally, the soil fertility was medium based on the above fertility indices.

ISSN: 2054-6319 (Print), 2054-6327(online)

The chemical composition of the cow dung slurry used is shown in Table 2.The Organic manure was relatively high in the essential nutrients required for the growth and development of crop.

Table 1: Pre-planting Soil Sample of the experimental site

Properties	Values
Clay	15.92
Silt	7.84
Sand	76.24
Textural class	Loamy sand
pH (H_2O)	5.6
Available phosphorus	8.02ppm
Total Nitrogen (%)	0.026%
Organic Carbon	0.52%
Calcium (Cmol/kg)	6.01
Magnesium (Cmol/kg)	4.60
Potassium (Cmol/kg)	4.31
Sodium (Cmol/kg)	0.93
Cation exchange capacity (C.E.C)	16.57
Exchangeable bases	15.85
Exchangeable acidity	0.72

Table 2. Chemical composition of the cow dung slurry used.

Properties	Cow dung slurry
Nitrogen (%)	1.34
Phosphorus (ppm)	1.56
Potassium (Cmol/kg)	0.94

Table 3: Effect of Cow dung slurry and NPK Fertilizer on number of leaves of Tomato Plant.

Treatment	2WAT	4WAT	6WAT	8WAT
T_0	7.75[b]	12.25[b]	23.5[b]	28.25[c]
T_1	10.25[a]	17.00[b]	28.25[b]	48.00[b]
T_2	10.25[a]	18.25[b]	26.25[b]	41.50[b]
T_3	8.75[b]	15.50[b]	28.75[b]	47.50[b]
T_4	10.25[a]	24.75[a]	40.25[a]	67.25[a]
L.S.D (0.05)	1.49	5.80	6.80	12.70

Mean within the same vertical column followed by the same small letters are not significant at 5% level of probability.

**LSD: Least Significant Difference*

ISSN: 2054-6319 (Print), 2054-6327(online)

At 2WAT, number of leaves treated with organic manure was significantly different ($p \leq 0.05$) from T_4 and T_3; there was no significant difference between T_4, T_2 and T_1. But T_4 was significantly different from T_0. At 4WAT, T_4 which has the highest yield was significantly different from all other treatments, also at 6WAT, T_4 which has the highest mean value of 40.25cm was significantly different from all other treatments. At 8WAT however, T_4 had the highest mean value of 67.25cm and was significantly different from T_3. Also T_4 was significantly different from T_0. There was no significant difference between T_1, T_2, and T_3. This result is in line with the literature which pointed out that tomato crop is a crop with major fertilization requirements (Badr *et al.*, 2011). During the vegetative stage, most of the nutrients are allocated towards the growth and development of plant (Jones, 1999).

Table 4: Effect of Cow dung slurry and NPK Fertilizer on stem girth of Tomato Plant.

Treatment	2WAT	4WAT	6WAT	8WAT
T_0	0.60^{bc}	0.68^{bc}	0.85^{c}	0.85^{b}
T_1	0.71^{b}	0.73^{b}	0.90^{ab}	1.10^{a}
T_2	0.70^{b}	0.75^{b}	0.83^{c}	0.95^{b}
T_3	0.68^{b}	0.80^{b}	0.93^{a}	0.95^{b}
T_4	0.75^{a}	0.90^{a}	1.00^{a}	1.10^{a}
L.S.D(0.05)	0.07	0.08	0.09	0.12

Mean within the same vertical column followed by the same small letters are not significant at 5% level of probability.

**LSD: Least Significant Difference*

At 2WAT, stem girth was observed to be insignificant ($p \leq 0.05$) between T_1, T_2 and T_3 but a significant different was found in T_4.

At 4WAT, T_4 recorded the highest mean stem girth of 0.90cm and was significantly different from all other treatments. T_2 was not statistically different from T_0.

At 6WAT, T_4 had the highest mean stem girth of 1.0cm which was significantly different from T_3 but was not statistically different from T_1 which had the mean value of 0.93cm and 0.90cm respectively. Also T_1 which has the mean stem girth of 0.90cm was observed to be significantly different from T_0 and T_2 which had the mean stem girth of 0.85cm and 0.83cm respectively. This is in line with the work of Makinde and Ayoola, (2008), who stated that, manures are usually applied at higher rates, relative to inorganic fertilizers. When applied at high rates, they give residual effects on the growth and yield of succeeding crops.

ISSN: 2054-6319 (Print), 2054-6327(online)

Table 5: Effect of Cow dung slurry and NPK Fertilizer on number of branches of Tomato Plant.

Treatments	2WAT	4WAT	6WAT	8WAT
T_0	3.75[b]	4.00[c]	4.50[c]	7.00[c]
T_1	4.00[b]	4.75[c]	5.5[b]	9.00[b]
T_2	3.25[bc]	5.75[b]	7.75[ab]	9.50[ab]
T_3	3.75[b]	4.25[c]	8.50[a]	10.75[a]
T_4	4.75[a]	7.00[a]	8.75[a]	12.25[a]
L.S.D(0.05)	0.68	0.99	1.00	1.93

Mean within the same vertical column followed by the same small letters are not significant at 5% level of probability.

**LSD: Least Significant Difference*

At 2WAT, T_4 had the highest mean value of 4.75 and was significantly different from all other treatments.

At 4WAT, T_4 highest mean value of 7.00 and was significantly from T_2 which has a mean value of 5.75. T_2 was significantly different from T_1 which has a mean value of 4.75. There was no significant difference between T_1 and T_0 but they were both significantly different from T_4.

At 6WAT, T_4 had the highest mean value of 8.75 and was not significantly different from T_3 but was statistically different fromT_2 which has the mean values of 8.5 and 7.75 respectively. However, T_1 was significantly different from the control (T_0) which had the mean value of 4.5.

At 8WAT, T_4 had the highest mean value of 12.25 and was not significantly different from T_3, but was statistically different from T_2. T_1 was significantly different from the control (T_0).

Table 6: Effect of Cow dung slurry and NPK Fertilizer on Number of Fruit per plant.

Treatments	Number of fruits per plant
T_0	2.25[e]
T_1	4.25[d]
T_2	5.50[c]
T_3	8.25[b]
T_4	9.75[a]
L.S.D(0.05)	0.78

Mean within the same vertical column followed by the same small letters are not significant at 5% level of probability.

**LSD: Least Significant Difference*

This table indicates that there was a significant difference observed in all the treatments. T_4 was found to be significantly different from T_3 at 5% level of probability and likewise, T_2 was significantly different from T_1 ($P \leq 0.05$).

It was observed that all the treatments were significantly different from T_0 (i.e, the control. This indicates that the application of cow dung slurry and NPK fertilizer has a significant effect on

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the number of fruits. Saxena *et al.*, (1975) reported that the application of organic manure increases the nutrient status of the soil and yield of tomato in the tropics. Also, Water soluble phosphorus fertilizers, such as nitro-phosphate or triple super phosphate are desirable to tomato for its rapid availability (Von, 1979). NPK fertilizer synthesizes phosphorus and phosphorus is a component of nucleic acid. It helps in the production of large number of blossoms in the early growth of tomatoes and early setting of fruits and seeds (Zobel, 1966). As a result, it increases the number and production of tomato fruits, with increased total soluble solids and acidity contents (Adamu *et al.*, 1997)

Table 7: Effect of Cow dung slurry and NPK Fertilizer on Fruit Diameter (cm)

Treatments	Harvest
T_0	**0.55^e**
T_1	**2.60^d**
T_2	**3.63^c**
T_3	**5.51^b**
T_4	**6.50^a**
L.S.D (0.05)	**0.61**

Mean within the same vertical column followed by the same small letters are not significant at 5% level of probability.

**LSD: Least Significant Difference*

Table 8 indicates the result of fruit diameter (cm) which was observed to be significantly different in all the treatments ($P \leq 0.05$). Fruit diameter was highest in T_4having mean fruit diameter of 6.50cm which is significantly different from T_3 which has a mean diameter of 5.51cm. T_2 has a mean diameter of 3.63cm and was found to be significantly different from T_1 which has an average diameter of 2.60cm. However, the control (T_0) had the lowest mean diameter of 0.55cm. This result is in line with the work of Gupta and Shukla (1977); who reported "an average increase in the number of fruits and size due to increase in N application" as nitrogen was released in sufficient amount from both organic and inorganic fertilizer used.

Table 8: Post-Harvest Soil Analysis Result

Treatment	Na	K	Ca	Mg	Exch.	ECEC	TEB	pH	%OC	P(ppm)	%TN
					Cmol/kg			Acidity			
		→			←						
T_0	0.94	4.33	6.21	4.31	1.48	10.01	15.79	6.12	0.24	22.66	0.032
T_1	0.97	4.38	6.42	4.70	1.51	10.36	16.47	6.38	0.43	22.78	0 .034
T_2	1.13	4.57	6.53	4.88	1.63	10.75	17.11	7.33	0.44	26.62	0.039
T_3	1.18	4.64	6.74	4.91	1.67	11.12	17.47	7.43	0.49	29.02	0.041
T_4	1.21	4.91	6.94	4.97	1.71	11.26	18.03	7.56	0.52	30.68	0.044

**TEB= Total Exchangeable Bases*
**ECEC= Effective Cations Exchange Capacity*
**%OC= Percentage Organic Carbon*

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Table 8; above shows the result of the post harvest soil analysis result. Comparing this table with the physical-chemical analysis in table 1, It is evident that the chemical and physical properties of the soil were influence due to the application of cow dung slurry (Organic manure) and NPK 15:15:15 fertilizer (Inorganic fertilizer). The application of organic and inorganic manure led to a rise in the pH of the soil as seen from the table. Also, certain soil nutrient and soil property such as magnesium and percentage organic carbon were increased as a result of the application of these manures (Table 8).

This result is in line with the work of Cooke (1972) who reported that the major nutrients required by the crop are Nitrogen (N), Phosphorus (P) and Potassium (K) and from the table, it is evident that these nutrients were increased with the addition of both manures (NPK 15:15:15 and Cow dung slurry).

The soil physical and chemical properties were also influenced by the application of cow dung slurry since the manure is known to improve the soil organic matter, macro-nutrient status and micro nutrient qualities of the soil (Maerere *et al.*, 2001).

The observation is consistent with the findings of Opara-Nadi *et al.,* (1987) and Arya *et al.*, (1991) who reported that pH increases with application of organic wastes. Akande *et al.,* (2003) confirms this finding that the application of organic material could ameliorate slightly acidic tropical soil to improve crop production.

Comparing the element sodium in table 9 above with that of table 1, it is evident the application of organic and inorganic manure has increase the volume of sodium in the soil.This element "K" increased with increase in the rate of application of the organic and inorganic manure in table 9 as compared to table 1.

There was an increase in the value of the calcium element after the application of the both manure, the value of the element increased as the rate of application of the manure was increased. Magnesium increased as a result of the application of both organic and inorganic manure. Although there was a decrease in the value of this element in the control T_0, this may be due to the uptake by the plant. Also, all other nutrients such as, the total nitrogen (TN) and available phosphorus all increased due to the application of both organic and inorganic manure but there was no sharp increase in the organic carbon which recorded the highest value of 0.52 after application of 8tons/ha of cow dung slurry and 50kg/ha of NPK 15:15:15 fertilizer as compared with the value obtained in the pre-planting analysis in table 1 (0.52). This may be due to the unavailability of the nutrient element in the inorganic fertilizer used and/or low availability of the element in the cow dung slurry used.

CONCLUSION

The study showed that use of inorganic and organic fertilizer had better effects on growth and yield of tomato. Application of organic and inorganic fertilizers also improved the chemical properties of the soil when compared to the control; although with the problems associated with inorganic fertilizer such as; high cost of purchase, scarcity, leaching, volatilization, environmental unfriendliness etc. have made inorganic fertilizer to be largely not recommendable as compared with organic fertilizer which is environmental friendly. More so, the low productivity of organic manure is associated with the fact that the mineralization is

ISSN: 2054-6319 (Print), 2054-6327(online)

slow compared to the inorganic fertilizer that is already in available forms for plant uptake, but prone to leaching and could not supply nutrients long in the soil compared to organic manure.

RECOMMENDATIONS

To ensure optimum growth and development and subsequent yield of tomato in the study area, it is recommended that Cow dung slurry at the rate of 15tonnes/ha (T_3) should be applied since it was not significantly different from (T_4). I recommend that further research be carried out to confirm this research.

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